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## NEW YORK STATE WORKS.

In the last number of this journal for 1839, we gave a not very flattering view of the prospects of State works in general, and we leave it to our readers to say, whether the reality has not more than borne out our predictions. We said (Vol. IX, 1839, p. 363,) "In some states, the grand argument will be, that if they can *complete* the works commenced, a revenue is immediately certain, which will render taxation to pay the interest unnecessary. That the completion of these projects will make the fortunes of many individuals, is well known, but, for the *permanent interests* of the State, the only plan is, to sell out at once with the present comparatively trifling loss. It is impossible to pay too much attention to the fact, that the greater part of the works projected by the governments of the different States are not such as will ever be of any essential benefit, and, when we add to this, that they are constructed at twice the cost of similar works in the hands of companies, are generally much inferior in execution and always managed and repaired in the most inefficient manner—we shall be at no loss to account for the present condition of State works in general."

Time has however shown, that, in our remarks on repudiation (in the following page) we egregiously overrated the "good faith" of only too many States, whose delinquency has caused an amount of suffering, here and in Europe, which is now past the possibility of cure; the original holders having in many cases disposed of their stock at a nominal sum, at least, a ruinous depreciation.

An insignificant amount of work has been done in the States of Ohio and Indiana since that time—during '40 and '41 large sums were expended in New York; and, during '42, in Canada alone have new works been undertaken. Considering the system of State works—as far as any new works are concerned—as defunct throughout the Union, New York *perhaps* excepted, we propose to offer our views on the prospects in that State.

The system, uniformly pursued during the last 20 years, of doing everything for the Erie canal counties—the lateral canals being mere feeders to supply the requisite votes to carry appropriations for the enlargement—as well as the present plan of taxing *all* the state to keep up these accommodations for a *part* of the state, can scarcely be tolerated any longer. To expend 30 to 40 millions for the purpose of effecting a reduction of 15 cents on the transportation of a barrel of flour from the western states to the Atlantic—and *that* reduction more than doubtful—will not hereafter be considered as more important, than, by an expenditure of less than one fourth of that sum, to insure the rapid construction of the main communications required in the State.

The canal system must be abandoned on account of the enormous capital invested in these works, as compared with railways—on account of their being closed, during at least one third of the year, and not accommodating when open, the travel which the railway has in addition to the freight of the canal. This travel again increases the freight, and thus with a much smaller capital we have a vastly greater income. It is impossible to conceive a stronger proof of the general belief in the superiority of railways, even as a means of carrying coarse freight, than the dread with which the legislature regards any measure tending in any way to, even at a distant day, permit them to enter the lists with the canal.

When the products of the people of *this* state are unable to find their way to market by the Erie canal and the adjacent railways, then may the enlargement be considered. Until that time and until the other parts of the state are as well accommodated as the central counties, the enlargement cannot be advocated without virtually disfranchising the rest of the state.

If the system of constructing works by the state be abandoned then the question as to the policy to be pursued becomes purely financial; but, if the system of Government works is to be continued, what kind of works shall be undertaken, and how shall they be carried on?

To the first question *we* at least answer, by railways, and not

the less readily, because we believe that opinion very general at present and rapidly extending—more especially among the farmers.

The second is more difficult. The Erie, Cattskill and Ithaca railways show, that loans to private companies have, in their cases, turned out failures, and though the entire loss will fall short of that on the Genessee valley canal alone—the works themselves being of *some* use to the public which can scarcely be said of that canal —the plan cannot be recommended without very important modifications. The necessity which exists, that the whole business of a railway must be under *one* head,—in other words, that the proprietors of the railway must be common carriers, precludes the idea of the state conducting these works by its own agents.

She may become a stockholder as in Massachusetts—the extent to be determined by the circumstances of the case. The able and elaborate article on this subject by "Fulton," (Vol. XI, 1840, pp. 358, etc.) renders any remarks of ours unnecessary, but we cannot help quoting his views (p. 361,) on the first question.

"The conviction is indeed very general that the canal system, pushed as it has been to an extreme, must, so far as it regards the construction of any new works, be abandoned, and the grave question arises, whether in the prosecution of the better improvement of railways, the arm of the State is necessary to its success.

The view we have taken of the subject has brought us to the conclusion that, whether right or wrong in the abstract, the aid of the State *will be invoked* and *successfully* in support of railways, and it becomes therefore an object of importance to ascertain the best and safest and most effective mode by which that can be rendered. It is for the purpose of contributing our mite to the enlightenment of the public mind, that the foregoing plan is presented, and unless such a plan, or one similar to it, is adopted, the state must continue the practice already partially introduced of aiding railway companies by a loan of its credit, or otherwise railroads, like canals, must be made State works."

The state may also furnish a certain sum per mile to build superstructure and to supply equipments per mile of *graded road* free from all encumbrance whatever. Or may loan money under certain restrictions, so that the interests of the company and the state may be the same—not antagonist. The discussion of details is however not required until the general policy has been determined on.

The farmers suffer much from the "State monopoly," even more

than either the manufacturers or merchants, and are rapidly making the discovery. They are already calculating the immense benefit they would *now* derive from its repeal, and find, that their pork, at Boston prices, would nett them 50 per cent. more than in the Rochester market.

Is the farmer to be forever excluded from the advantages of railways, because the state owns the Erie canal? Does not the falling off in the receipts of the Albany and Boston railway show the sacrifice of the interests of the farmer to bolster up the Erie canal.

For, freight is, by the peremptory mandate of the State, to remain on the banks of the canal from November till nearly May, thus depriving the farmer of the use of his money during the entire winter, and, in the spring—after paying (directly or indirectly,) storage, insurance, etc.—his produce sells at a lower price. The course of legislation has been for years, to give the farmer a route open during the months when he is busy producing, and closed during the months when his productions are ready for market—to shut him out when the demand is greatest and prices uniformly highest—to, in a great measure, allow him to be forestalled by Baltimore and New Orleans in supplying the great and rapidly increasing demand for pork, beef, butter, cheese and lard, *during the winter*, for shipment to Europe. Lastly, to pay a tax on every thing he has in the world for these inestimable blessings!

The merchant is idle during the winter and loses a large amount of trade altogether. It is quite immaterial to him whether produce reach him by the channel of the Erie canal or by railway—so also with the manufacturer. Cheapness and regularity are all they require. Their interests therefore, as well as those of the farmer, are diametrically opposed to the enlargement of the Erie canal, the object of which is not to furnish the grand desideratum of a less tardy communication open throughout the year, but, to perpetually restrict the so called *free* and enlightened citizens to a channel open only eight months in the year, and even then offering inferior advantages to those which private enterprise will furnish without any taxation.* It does appear to us that, to go on with the enlargement, under existing circumstances, is literally "adding insult to injury."

The only public work of importance which can now be said to

* *Not* only so, but these private railways actually pay a large amount to the towns through which they pass—the Utica and Schenectady railway alone paying to the towns 14,000 dollars per annum!

be fairly before the public on its own merits, is the New York and Albany Railway, and it is likely to have much influence on the future policy of the state.

The wealth, business and population of the counties, *through* which this work is to run, will eventually accomplish all by their own unaided efforts. These counties will pay *more than half the state tax* imposed to pay the interest on works in which they have not and never can have the least imaginable interest, (the N. Y. and Erie railway excepted,) as the enlargement, Chenango, Black river and Genessee valley canals, on which about 18 *millions have been expended!*—twice the amount lost in the great fire of 1835!

The river counties have—exclusive of New York—much weight in the legislature. They cannot be expected to agree, on *any* terms to *any* expenditure of money, on *any* public work whatever, if they are obliged to construct the New York and Albany Railway at *their own* cost exclusively. Look at the counties of Rockland and Orange, in which two millions have been spent on the New York and Erie Railway, at the counties traversed by the Chenango, Genessee valley and Black river canals, and compare their wealth, population and the amount of tax they will pay as compared with the sum drawn from the river counties—even omitting the city of New York. Hence we conclude that the New York and Albany Railway will have great weight in the approaching death struggle between the railway and canal systems.

The following are the total appropriations we should recommend, say one million per year for 5 years.

| | | |
|---|---|---|
| N. Y. & E. R. R. | $2,000,000. | (in addition to the 3,000,000.) |
| N. Y. & A. R. R. | 1,500,000. | |
| Northern N. Y. | 1,500,000. | (including completion of Saratoga and Whitehall Railway, |
| | $5,000,000 | |

Again, we cannot see the propriety of taxing *all*, including those who derive no benefit from the Erie canal, instead of raising the required amount by a slight increase of toll, and thus tax those, *and those only*, who receive an *equivalent* in return. A considerable sum would thus be derived from other states, which derive immense advantages from the Erie canal. We quote again from (Vol. 10, 1840, p. 4,) our remarks on this subject three years since,

"Now, the Erie canal is a work as general in its character as any undertaking of the kind can well be, yet, beyond a distance of 25 or 30 miles, its *beneficial* influence ceases, and it is notorious, that it has been the means of retarding the advancement of the

southern and northern counties by offering every inducement to the husbandman to leave his native state, because it costs less to send his produce to market from Ohio and Michigan than from nearly one half the state of New York. The western states offer great natural inducements to settlers, and it would be as unfair to *them* to attempt to check the tide of emigration as it is unjust to our own citizens to use indirect but most powerful means to retard the settling of *our* northern and southern counties. The views of our legislators appear to be too enlarged to be confined to their own state; and we would respectfully, but earnestly ask, Has the government of New York the *right* to tax her citizens in order that the property of the inhabitants of *other* states or provinces may be carried to and from the seaboard more cheaply than at present rates? Not only is the New York farmer to be taxed, but the amount so levied is to be expended in reducing the value of his property by adding, at his cost, great artificial to the already superior natural advantages of the west, and thus enabling the inhabitants of that region to undersell him in his own market. The entire course of New York legislation for many years appears to have had in view nothing higher, than to direct the energies and resources of government towards aiding the interests of forwarders and brokers at the expense of the farmer, the regular merchant and the mechanic, who require no exclusive privileges to enable *them* to carry on their business. Thus, the idea that the enlargement would bring to the Erie canal a few thousand more tons of freight, and lead to the sale of a few additional bales of goods, has been considered of more importance than to double the population and wealth of the state in ten years, by developing the resources of the northern and southern counties."

We repeat, that the enlargement of the Erie canal will not only not afford the additional accommodations required by the advanced state of the country through which it passes, but it will effectually prevent any facilities whatever being afforded to other parts of the state— in other words, it stops the onward march of improvement in the the canal counties, and extinguishes all hope of *any* facilities being extended to the northern, southern or river counties. It also swallows up in a single year, $4,000,000, very nearly as much as we have above considered sufficient to *complete all* the required communications in the state and to be expended in 5 years.

When we consider the enormous cost of the enlargement with its inseparable concomitant, the state monopoly, it is not easy to

exaggerate their withering influence on the agricultural and commercial interests of the state or on the progress of the public works really demanded by the wants of the country.

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## ON THE RELATIVE PROPERTIES OF IRON.

*Made by the use of Cold and Hot Air Blast, in the Smelting Furnace; lately read before the West-Riding Geological and Polytechnic Society.* By Henry Hartop, Civil Engineer and Mineral Surveyor.

In the early part of the year 1829, the use of hot air in the smelting furnace, for the manufacture of cast iron, was introduced at the Clyde Iron Works, near Glasgow, and at the fourth meeting of the British Association, held at Edinburgh in 1834, Dr. Clark gave an account of its success as follows:—

That in their previous operations with cold air, 8 tons, 1 cwt., 1 qr. of splint coal (made into coke, at a loss in weight of 55 per cent,) were required to make 1 ton of iron.

With the use of air heated to about 300° Fahrenheit, 5 tons, 3 cwt., 1 qr. of coal (in coke) produced a ton of iron, in addition to which, 8 cwt. of coals were used for heating the air.

In 1833, the temperature of the air used being 600° Fahrenheit, it was found that raw coal (not coked) might be used, which circumstance further reduced the quantity of coal required in the furnace to 2 tons, 5 cwt., 1 qr per ton of iron made.

Not having been present at Edinburgh, on the Association's meeting, the following year, in Dublin, I stated that the case had not been correctly represented to Dr. Clark,[1] inasmuch, as for some time previous to 1825, a saving in the coking operation had been

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[1] A similar misrepresentation has also been made to Mr. Mushet, by reason of which he has been led into an error so far as to state in his most valuable work on iron and steel, pages 922, 923, that the materials used at the Milton Works in December 1834, with cold blast, were for each ton of iron made—

| | tons. | cwt. | lb. |
|---|---|---|---|
| Coals - - - - - | 6 | 3 | 2 |
| Ironstone - - - - | 4 | 1 | 0 |
| Limestone - - - - - | 0 | 13 | 0 |

At the same works in December 1836, with hot blast—

| | tons. | cwt. | qrs. | lb. |
|---|---|---|---|---|
| Coals per ton of iron in the furnace - | 2 | 4 | 3 | 14 |
| Ironstone - - - - - - | 3 | 11 | 2 | 21 |
| Iron Ore - - - - - | 0 | 0 | 1 | 0 |
| Limestone - - - - - - | 0 | 16 | 0 | 14 |

It is, however, well known, that on an average of the year through, previous to April, 1829, when cold blast was used at the Milton Works, the materials consumed were—

made at every well-conducted iron work, by which a ton of iron could be made with 5 tons of splint coal in the furnace, when cold blast used, so that in reality a saving only took place by increasing the temperature of the air, so far as to enable them to use coal uncoked in the smelting furnace, from 5 tons to 2 tons 15 cwt., or 2 tons 5 cwt.

The account, therefore, as regards economy, by the use of hot air, will stand thus:—

| | tons. | cwt. | *s.* | *d.* | £ | *s.* | *d.* |
|---|---|---|---|---|---|---|---|
| Saving in coal used in the furnace | 2 | 5 | 5 | 0 | 0 | 11 | 3 |
| In Coker's Wages | | | | | 0 | 2 | 3 |
| | | | | | £0 | 13 | 6 |
| Against this may be set down— | | | | | | | |
| A greater quantity of ironstone used per ton of iron made | 0 | 3 | 8 | 6 | 0 | 1 | 3 |
| Extra wear on ditto | | | | | 0 | 3 | 6 |
| Coal to heat the air used | 0 | 8 | 2 | 0 | 0 | 0 | 10 |
| | | | | | £0 | 5 | 7 |
| Saving in materials by the use of hot air, per ton of iron | | | | | 0 | 7 | 11 |

To which saving may be added a further sum of 4*s.* 7*d.* per ton, for the greater quantity of iron produced from each furnace, when hot air and coals are used, making the total saving of 12*s.* 6*d.* per ton of pig iron.

But in 1835, the deterioration in the value of iron so made was about 17*s.* 6*d.* per ton, as I stated at Dublin, and at the present time (March 1842,) I have no recantation to read so far as the above observations go.

In Dublin my observations on the deteriorated value of hot blast iron in the market of 17*s.* 6*d.* per ton were contradicted, but after seven more years of unceasing application, practised in the manufacture on a very large scale, of numerous experiments by indefatigable practical men of great ability, of the attention of learned professors of chemistry, mineralogy, and geology, together with the aid of that no inconsiderable engine the public press, the price of pig iron so made is 32*s.* 6*d.* per ton below that made by cold blast in the smelting furnaces.[a]

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| | tons. | cwt. | qrs. | lb. | |
|---|---|---|---|---|---|
| Coals in the furnace | 4 | 18 | 0 | 0 | per ton |
| Ironstone do | 3 | 14 | 3 | 9 | of Iron |
| Limestone do | 0 | 14 | 3 | 23 | made. |

And in comparing this with the make by hot air, in December 1836, (one of the best months in the year for iron making) an addition of 8 cwt. of coal being made for heating the air, the difference is truly so small as to be altogether unworthy of consideration, on taking into account the deteriorated value of the produce.

[a] March 1842. per ton
Price of Scotch hot blast iron at Hull, (No. 1.) £3 7 6

If you ask why iron so made is sold for 32*s.* 6*d.* less in the market, the answer is 1st, "its great weakness under *impact*, and therefore its total unfitness for most purposes in which the greatest weight of iron is used.[*] 2d. Its greater loss in remelting in the cupola of 2 cwt. per ton. 3rdly, The great irregularity in the contraction of castings when cooling, if made from hot blast iron, on which account many castings of different sizes are produced from the same pattern, causing great expense in their after fitting, or if this expense is not incurred, great defect in all machinery, etc., so made. 4th. Its unsoundness, that when made into castings require to be turned, bored, or planed, etc., on which occasions, if the surface operated upon is not defective on its entire area, a defect so considerable will show itself, probably when nearly finished, that both the casting and the great expense bestowed upon it will be thrown away, and in many such cases the expense of making the casting itself will be at least three times greater than even the present great difference in the value of the two kinds of iron.

I need not unnecessarily occupy your time further than by going more fully into the first of these points, the great weakness, under impact, of hot blast iron.

My attention was first called to the subject by observing great quantities of pig iron on the wharfs at the iron foundries and other places in this neighborhood, very recently broken into pieces so short as to prevent the laborer piling them in cubical tiers in the

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| | |
|---|---|
| Amount brought forward. | £2 7 6 |
| To which add for its general inferiority to Yorkshire iron | 0 5 0 |
| | 3 12 6 |
| Price of Yorkshire cold blast iron at Hull, (No. 1.) | 5 5 0 |
| Difference in favor of cold blast iron generally | 1 12 6 |

[*] In Mr. Fairbairn's recent experiments, published in the Manchester Memoirs, the difference in this respect is very striking:—Each bar being 1 in. square and 4 ft. 6 in. long between supports.

| | Breaking weight. | Power to resist impact. |
|---|---|---|
| Oldberry cold blast iron | 453 lbs. | 822 lbs. |
| Oldberry hot do. | 543 | 549 |
| Using the same coal and ironstone, | | |
| Elsecar cold do. | 446 | 992 |
| Milton hot do. | 353 | 538 |
| Working in the same mineral field in N. Wales, | | |
| Ponkey cold do. | 567 | 992 |
| Plaskynaston hot do. | 378 | 175 |

usual manner, and on inquiry, I found that they were so broken by loading and reloading, and that they were made by the new process of using hot air in the furnace, greatly miscalled an improvement in the manufacture of cast iron. From these and other circumstances I thought it a duty due to the iron trade to call the attention of the public to it, and having mentioned the subject at the meeting of the British Association in Dublin, its importance was at once recognised, and a sum of money appropriated for making the needful experiments, which were carried into execution by Mr. Fairbairn, the highly intelligent and indefatigable engineer of Manchester; and I was very sorry to see in his report read at the Liverpool meeting, as well as in several conversations with me on the subject, to find that he had experienced great difficulty in ascertaining the composition of the irons experimented upon, in consequence of many of the manufacturers being unwilling to give information; added to this, it is well known that in more recent experiments, one of the strongest irons in Yorkshire has been placed in the scale of strength so much below other iron, long since known to be no stronger, both irons being made from the same coal and ironstone, a fence only parting the mineral fields of each work, that I am driven to the conclusion that the object of the experiments in question has in a great measure been defeated. There are, however, some experiments in them, which may not have been affected in their results by these circumstances, two of which I shall point out for your consideration.

The first will be that of iron from two works using the same materials.

| | | | | | |
|---|---|---|---|---|---|
| Elsecar iron (cold blast) mean ratio of its strength | | | | | 1000 |
| Milton iron (hot blast) mean ratio of its strength | | | | | 809 |
| Elsecar iron mean ratio of power to resist impact | | | | | 1000 |
| Milton | do | do | do | do | 858 |

In this case, however, the difference is much greater than appears on the face of these experiments, inasmuch as the specimens of pig iron from the Milton Works were made with the addition of a portion of the red hematite iron ore from Ulverstone, for the express purpose of giving greater strength to that iron, as was invariably done many years for the purpose of making tin plate, and during the war for the casting of cannon.

The second circumstance is that where Mr. Fairbairn states that in a trial of 50 sorts of iron, of which each bar[1] of hot and cold blast iron were made of the same materials, and under the same circumstances.

Cold blast iron, with a load of 392 lb. increased the deflection in 108 days from 1·786 to 1·843 inches.

Hot blast iron do. do 1·891 to 1·966 inches.

Cold blast iron with a load for 448 lb. continued to increase in deflection, and ultimately broke, after sustaining the weight 35 days.

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[1] I take this to mean each pair of bars.

*All the hot blast iron bars broke in the act of loading them with the above weight* 448 *lb.*

Notwithstanding these and many similar facts brought out by the experiments in question, certain portions of them are constantly being quoted through the press for the purpose of proving that iron made by hot air is stronger than that produced by the use of cold air.

Contemporary with these experiments on a small scale, others of far greater importance have been going on; and we hear of hundreds of railway chairs, cast from iron made by the improved process, constantly breaking where tens only broke before,[5] of steam engines and other valuable machinery breaking in rapid succession and in parts where, by regular work, they were never known to give way before the introduction of the improved iron—of the more respectable portion of mill-wrights being obliged to make new calculations, and a new stock of patterns, in order to lessen, as far as is in their power, the enormous losses and the great disappointment of their friends by such breakages. We hear of districts of coal masters and other prudent and humane proprietors of large establishments indroducing clauses in their contracts for castings, stipulating that no hot blast iron shall be used therein; and at length the same has become common in contracts for gas and other pipes, which it has hitherto been usual to make of the most inferior quality of irons, it having been found that the sockets of some miles of piping have been broken off in one or two years after being laid down, in consequence of their having been made of hot blast iron.

There has, however, still more recently been a series of experiments made, upon which a far greater dependence may be placed, inasmuch as the irons were all supplied in the regular way of business, without the makers knowing any such experiments were intended; and they were undertaken for the purpose of information only, to guide the founder and engineer who conducted the operations at his own establishment. The detail of these valuable trials by Mr. Todd, of Leeds, formed a paper read before this Society when last it met at Leeds; I need not therefore occupy your time with repeating them, and here, will only call your attention to a few of the results, for the purpose of more clearly explaining what I wish particularly to impress on your notice.[6]

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[5] In a paper recently read before the Institution of Civil Engineers, Mr. Macneill states that on the Dublin and Drogheda Railway, where chairs were used made of hot blast iron from Scotland, the breakage was very great as compared with those on the South Eastern Railway, which were made of cold blast iron, and that in his opinion the latter would be cheaper than the former at an increased price of 4*l.* per ton.

[6] They took place from August, 1840, to February, 1841.

| | | Breaking weight cwt. qr. |
|---|---|---|
| Bierley pig iron, No. 3, made with cold blast | average | 25 2 |

With respect to the strength of bar iron made from hot blast pig iron, very few experiments have been made public that I am aware of; they are, however, of very great importance, because they were made with the greatest possible care, and regardless of expense, by manufacturers of the first eminence and ability for their private information. The irons were eight in number; the first set of bars were 2¼ inches in diameter, made with cold blast scraps and hot blast respectively, all by Yorshire manufacturers. The weight required to draw them asunder by a steady direct tension was not very variable, but when all were cut round to the same depth, for the purpose of being broken with the hammer, they required about the following blows to do so:—

| | Blows |
|---|---|
| Cold blast iron - - - - - - - | 6 |
| Scrap - - - - - - - | 3 |
| Hot blast - - - - - - - - | 1 |

The second and third set of bars you have now before you, the result of experiments on which stand thus:

| | Diam. of bar. in. | Area of sec. where cut. | Blows required to break them with a 17lb. hammer. |
|---|---|---|---|
| Low Moor cold blast | 2·66 | 3·976 | 18 |
| Bierley cold blast | 2·75 | 4·430 | 18 |
| Milton hot blast | 2·75 | 4·430 | 3 |
| | | | Blows required to break them with a 20 lb. hammer. |
| Elsecar cold blast | 2·58 | 3·976 | 21 |
| Milton hot blast | 2·58 | 4·203 | 1½ |

Made from the same materials.

So that the proportionate resistance of hot blast wrought iron to *impact* is still less than that of cast iron. I need scarely say, cold blast iron was ordered at probably 6*l.* per ton more than the hot blast iron might have been bought for.

I may here take leave to mention the circumstance of scrap iron being any thing now but what it was formerly, when its name and

| | | | | | |
|---|---|---|---|---|---|
| | | Brought forward, | | 25 | 2 |
| Elsecar do. | 3, | do | do | 24 | 0 |
| Low Moor do. | 3, | do | do | 23 | 2 |
| Summerlee (Scotch) | 3, | hot blast | do | 17 | 2 |
| Level Staffordshire | 3, | do | do | 16 | 0 |
| Mixed pig iron | 3, | 5 parts Low Moor, 1 part Elsecar | do | 30 | 0 |
| Mixed pig iron | 3, | 5 parts Bierley, 1 part Elsecar | do | 33 | 0 |
| Mixed pig iron | 3, | equal parts Bierley, Elsecar, Low Moor, Staffordshire, (Cylinder iron in the market,) and also, Summerlee | do | 20 | 2 |

excellent quality were synonymous. In former times the importation of scraps from the continent of Europe took place to a very considerable extent, all of which were manufactured in this country into bars, sheets, etc.; and from the circumstance of these scraps, being all of charcoal iron, the bars, etc., so made, could not but deserve the good name they acquired and long maintained. The flow of scraps into England has, however, long since ceased, and the exportation from this country having become a considerable trade, it follows, of course, that scrap iron now must be made from our own scraps; and when it is remembered how small a proportion of good iron to bad has for many years been made here, bars, etc., manufactured from them cannot but be of very irregular and dubious quality, hence it is that the best scrap iron cuts so poor a figure when compared with a well made iron from known good minerals.

The remarks I have made are in reference to irons of known good quality, but I am ready, and have pleasure in admitting that the use of hot air has been of very great advantage at those iron works whose produce had not a first-rate name, by enabling their proprietors to make it at a less cost, without a proportionate deterioration in quality; and there are some few works whose iron, made with cold blast, was so bad, that any change could not be but for the better. There is also at present a strong impression that iron cannot be made with anthracite coal only, but with hot air, and that iron so made is better than any other. The goodness of its quality is, however, due to the great purity of that coal. But even here we are told, in a paper read before the Polytechnic Society of Cornwall, by a gentleman of great practical skill, that iron made with such proportions of anthracite coal and coke as enabled him to use cold blast, became much weaker on his using hot air, all other circumstances being the same.

My apology in troubling you so far must be in the importance of the subject, and the daily increasing importance to society of the strength of that material by which the locomotive power is applied that so rapidly conveys a very large portion of the human race both by land and sea. When we are about to purchase a horse which is to convey ourselves and families at the moderate rate of 8 or 10 miles an hour, with what inherent caution our first object is to examine his knees, to ascertain his safety! In the steam-engine we are prevented taking this precaution, and yet in travelling three times as fast, our risk is in very much greater proportion. Now in this fast travelling it must not be forgot that in the engines which convey us there are two cylinders, and at least 280 returns of the piston, and therefore there are 280 precussions each minute of 9,240lb. pressure in the power itself, and also the tires of about 42 wheels and axles in each train, passing over a joint of the rails every 5 yards of our journey, the percussions of which are very sensibly felt, with numberless others of minor effect, by which it will be at once seen of what inestimable importance it is that all iron used for such purposes should not only be strong, but

be so under percussion; for I need only remind you that it is more than probable, should any one of the numerous parts give way, by any one of the many percussions they have to sustain, that an accident of the most calamitous nature would be the result.

With this view of the subject I may probably be excused, if I so far further trespass on your patience as at least to endeavor to point out a duty which the public only can perform for itself, namely, to take especial care that the needful protection is given to that class of iron makers whose first care it is to maintain its utmost strength regardless of the expense of doing so. And in order that it may be understood how far such protection is required, the following statement should be made known. In the year 1830 the total quantity of pig iron made in Great Britain was about 653,500 tons. In 1840 the make had increased to 1,396,400 tons; and although the stock of pig iron at the latter date was very small, the price of No. 1 had declined since the use of hot air from 8*l.* 5*s.* in 1836, to 5*l.* 5*s.* per ton in 1842 for cold blast iron; and from 7*l.* 5*s.* to 3*l.* 12*s.* 6*d.* per ton for hot blast iron,[7] although the workmen's wages throughout that period were rather higher, which item forms nearly 75 per cent., of the cost, from which circumstance it has been very fairly concluded, that the price of the best pig iron made has been brought down at least 30*s.* per ton lower than it would otherwise have been by the badness of trade generally, had not the use of hot air been introduced in its manufacture.

In addition to the observations I have already made on this subject, I may refer to the price current of the present day, and those who do so will see the price of cold blast pig iron in South Wales stand at 3*l.* 10*s.* per ton for No. 1; hot blast pig iron in the Clyde, 2*l.* 10*s*, per ton for No. 1; and, upon the whole, it seems this case may now be thus summed up, that—

| | per ton |
|---|---|
| The saving in the make of pig iron by the use of hot blast may (generally speaking) be | £0 12 6 |
| Deteriorated value of such iron in the general market | 1 0 0 |
| Deteriorated value in the Yorkshire district | 1 12 6 |
| Deteriorated value of castings made of such iron, in the simple article of railway chairs, as reported to the Institution of Civil Engineers, on the 1st day of March last, by one of their own body, of the first eminence, and of very great experience in such matters | 4 0 0 |
| Deteriorated value of wrought iron when manufactured from pig iron so made, in the market | 6 0 0 |

Indeed, of the last-named iron, engineers and intelligent manufacturers are agreed, and the experiments I have before referred to, show that 6*l.* per ton is far too little a deterioration for bar-iron of such a quality, and particularly when we reflect how very much bar (and other) iron has now to do with the personal safety of millions of our fellow-creatures.—*Barnborough Hall, near Rotherham.*

[7] I have been informed that No. 1 hot blast iron has been delivered in Leeds for 3*l.* 2*s.* 6*d.* per ton, the average of former years being 9*l*, 10*s.* per ton for No. 1 cold blast pig iron.

We need offer no apology to our readers for the length of the following article. The great interest attached to the Telegraph of Professor Morse and the vast utility which will result from its introduction renders the subject particularly interesting to the Profession as in course of time we hope to find it among the necessary equipage of a Railroad.

The History of his invention by Professor Morse is particularly worthy of perusal.

### ELECTRO-MAGNETIC TELEGRAPHS.

DECEMBER 30, 1842.

Mr. Ferris, from the Committee on Commerce, made the following

REPORT.

That they regard the question, as to the general utility of the telegraphic system, settled by its adoption by the most civilized nations; and experience has fully demonstrated the great advantages which may be derived from its use. Its capability of speedily transmitting intelligence to great distances, for national defence, and for other purposes, where celerity is desirable, is decidedly superior to any of the ordinary modes of communication in use. By it, the first warning of approaching danger, and the appearance of hostile fleets and armies on our coasts and borders, may be announced simultaneously at the most distant points of our widely-extended empire, thus affording time and opportunity for concentrating the military force of the country, for facilitating military and naval movements, and for transmitting orders suitable to the emergency.

In the commercial and social affairs of the community, occasions frequently arise, in which the speedy transmission of intelligence may be of the highest importance for the regulation of business transactions, and in relieving the anxious solicitude of friends, as to the health and condition of those in whose fortunes they feel an interest.

The practicability of establishing telegraphs on the electric principle is no longer a question. Wheatstone, of London, and his associates, have been more fortunate than our American inventor, in procuring the means to put his ingenious system into practical use for two or three hundred miles, in Great Britain; and the movements of the cars on the Blackwall railroad are at this time directed with great economy, and perfect safety to life and property, by means of his magnetic needle telegraph. If a system more complicated and less efficient than the American telegraph is operated for great distances in England, with such eminent success and advantage, there can be no reasonable doubt that, if the means be furnished for putting in operation the system of Professor Samuel F. B. Morse, of New York, the original inventor of the electro-mag-

netic telegraph, the same, if not greater success, will be the result. Your committee are of opinion that it is but justice to Professor Morse, who is alike distinguished for his attainments in science and excellence in the arts of design, and who has patiently devoted many years of unremitting study, and freely spent his private fortune, in inventing and bringing to perfection a system of telegraphs which is calculated to advance the scientific reputation of the country and to be eminently useful, both to the Government and the people, that he should be furnished with the means of competing with his European rivals.

Professor Morse bases his system upon the two following facts in science:

First. That a current of electricity will pass to any distance along a conductor connecting the two poles of a voltaic battery or generator of electricity, and produce visible effects at any desired points on that conductor.

Second. That magnatism is produced in a piece of soft iron (around which the conductor, in its progress, is made to pass) when the electric current is permitted to flow, and that the magnetism ceases when the current of electricity is prevented from flowing. This current of electricity is produced and destroyed by breaking and closing the galvanic circuit at the pleasure of the operator of the telegraph, who in this manner directs and controls the operation of a simple and compact piece of mechanism, styled the register, which, at the will of the operator at the point of communication, is made to record, at the point of reception, legible characters, on a roll of paper put in motion at the same time with the writing instrument. These characters the inventor has arranged into a conventional *alphabet*, which is contained in the letter appended to this report, and which is capable of being learned and used with very little practice.

Professor Morse has submitted his telegraphic plan to the severe scrutiny of European criticism; and the Academy of Sciences, of Paris, the highest scientific tribunal in the world, hailed it with enthusiasm and approbation, when its operation was exhibited, and its principles explained by their distinguished perpetual secretary, M. Arago.

It appears, from documents produced by Professor Morse, that the thanks of several learned bodies in France were voted to him for his invention, and the large medal of honor was awared to him by the Academy of Industry. It further appears, that several other systems of telegraphs on the electric plan (among which were Wheatstone's, of London, Steinheil's, of Munich, and Masson's, of Caen) had been submitted at various times for the consideration of the French Government, who appointed a commission to examine and report on them all, at the head of which commission was placed the administrator-in-chief of the telegraphs of France, (M. Foy,) who, in a note to Professor Morse, thus writes:

"I take a true pleasure in confirming to you in writing that which I have already had the honor to say to you vive voce—that I have

prominently presented to Monsieur the Minister of the Interior your electro-magnetic telegraph, as being the system which presents the best chance of a practical application; and I have declared to him that, if some trials are to be made with electric telegraphs I do not hesitate to recommend that they should be made with your apparatus."

Your committee, in producing further evidence of the approbation by the scientific world of the system of Professor Morse, would cite the letter of Professor Henry, of Princeton College, well known for his eminent attainments in electrical science, (marked A,) in the appendix of this report.

More recently, a committee, consisting of some of our most distinguished scientific citizens, was appointed by the American Institute of New York to examine and report upon this telegraph, who made the report (B) in the appendix. In compliance with the recommendation of this report, the Institute awarded to Professor Morse the gold medal.

Besides the evidence these testimonials furnish of the excellence of Professor Morse's system, your committee, as well as the greater part of the members of both Houses of Congress, have had a practical demonstration of the operation of the electro-magnetic telegraph, and have witnessed the perfect facility and extraordinary rapidity with which a message can be sent by means of it from one extremity of the Capitol to the other. This rapidity is not confined in its effects to a few hundred feet, but science makes it certain that the same effects can be produced, at any distance on the globe, between any two given points connected by the conductors.

Your committee have alluded to other electric telegraphs; for, as is not uncommon in the birth of great inventions, scientific minds have, at nearly the same period of time, in various parts of Europe conceived and planed electric telegraphs; but it is a matter of national pride, that the invention of the *first electro-magnetic telegraph*, by Professor Morse, as well as the *first conception* of using electricity as the means of transmitting intelligence, by Doctor Franklin, is the offspring of American genius.

Your committee beg leave to refer to the letter of Prof. Morse, (marked C,) in the appendix, to C. G. Ferris, one of the committee giving, at his request, a brief history of the telegragh since it was before Congress, in 1838, for some interesting information concerning it, and for Professor Morse's estimate of the probable expense of establishing his system of telegraphs for thirty or forty miles.

They would also refer to the House document No. 15, (December 6, 1837,) and to House report No. 753, (April 6, 1838,) for valuable information on the subject of telegraphs,

Your committee invite special attention to that part of Professor Morse's letter which details the plan of a *revenue* which may be derived from his telegraphic system, when established to an extent sufficient for the purposes of commercial and general intelligence. From these calculations, made upon safe data, it is probable that an

income would by derived from its use by merchants and citizens more than sufficient to defray the interest of the capital expended in its establishment. So inviting, indeed, are the prospects of profit to individual enterprise, that it is a matter of serious consideration, whether the Government should not, on this account alone, seized the present opportunity of securing to itself the regulation of a system which, if monopolized by a private company, might be used to the serious injury of the Post Office Department, and which could not be prevented without such an interference with the rights of the inventor and of the stockholders as could not be sustained by justice or public opinion.

After the ordeal to which the electro-magnetic telegraph system has been subjected, both in Europe and in America, and the voice of the scientific world in its favor, it is scarcely necessary for your committee to say that they have the fullest confidence in Professor Morse's plan; and they earnestly recommend the adoption of it by the Government of the United States. They deem it most fortunate that no definite system of telegraphs should hitherto have been adopted by the Government, since it enables them to establish this improved system, which, in the opinion of your committee, is decidedly superior to any other now in use, possessing an advantage over telegraphs depending on vision, inasmuch as it may be used both by night and day, in all weathers, and in all seasons of the year, with equal convenience; and also, possessing an advantage over electric telegraphs heretofore in use, inasmuch as it records, in permanent legible characters on paper, any communication which may be made by it, without the aid of any agent at the place of recording, except the apparatus which is put in motion at the point of communication. Thus, the recording apparatus, called the register, may be left in a closed chamber, where it will give notice of its commencing to write by a bell, and the communication may be found on opening the apartment. Possessing these great advantages, and the means of communication not being liable to interruption by the ordinary contingencies which may impede or prevent the successful action of other telegraphs, the advantages to be derived from it will soon be apparent to the community, and it will become the successful rival of the Post Office, when celerity of communication is desired, and create a revenue from which this system of telegraphs may be extended and ramified through all parts of the country, without imposing any burden upon the people or draughts on the Treasury, beyond the outlay for its first establishment.

As a first step towards the adoption of this system of telegraphy by the Government, your committee recommend the appropriation of thirty thousand dollars, to be expended under the direction of the Postmaster General, in constructing a line of electro-magnetic telegraphs, under the superintendance of Professor Samuel F. B. Morse, of such length and between such points as shall fully test its practicability and utility; and for this purpose they respectfully submit the following bill:

**A BILL** to test the practicability of establishing a system of electro-magnetic telegraphs by the United States.

*Be it enacted by the Senate and House of Representatives of the United States in Congress assembled,* That the sum of thirty thousand dollars be, and is hereby, appropriated, out of any moneys in the Treasury not otherwise appropriated, for testing the capacity and usefulness of the system of electro-magnetic telegraphs invented by Samuel F. B. Morse, of New York, for the use of the Government of the United States, by constructing a line of said electro-magnetic telegraphs, under the superintendence of Professor Samuel F. B. Morse, of such length and between such points as shall fully test its practicability and utility; and that the same shall be expended under the direction of the Postmaster General, upon the application of said Morse.

Sec. 2. *And be it further enacted,* That the Postmaster General be, and he is hereby, authorized to pay, out of the aforesaid thirty thousand dollars, to the said Samuel F. B. Morse, and the persons employed under him, such sums of money as he may deem to be a fair compensation for the services of the said Samuel F. B. Morse, and the persons employed under him, in constructing and in superintending the construction of the said line of telegraphs authorized by this bill.

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## A.

Princeton College, February 24, 1842.

*My Dear Sir:*—I am pleased to learn that you have again petitioned Congress in reference to your telegraph, and I most sincerely hope that you will succeed in convincing our Representatives of the importance of the invention. In this you may, perhaps, find some difficulty, since, in the minds of many, the electro-magnetic telegraph is associated with the various chimerical projects constantly presented to the public, and particularly with the schemes, so popular a year or two ago, for the application of electricity as a moving power in the arts. I have asserted, from the first, that all attempts of this kind are premature, and made without a proper knowledge of scientific principles. The case is, however, entirely different in regard to the electro-magnetic telegraph. *Science is now fully ripe for this application,* and I have not the least doubt, if proper means be afforded, of the perfect success of the invention.

The idea of transmitting intelligence to a distance by means of electrical action has been suggested by various persons, from the time of Franklin to the present; but until within the last few years, or since the principal discoveries in electro-magnetism, all attempts to reduce it to practice were necessarily unsuccessful. The mere suggestion, however, of a scheme of this kind is a matter for which little credit can be claimed, since it is one which would naturally arise in the mind of almost any person familiar with the phenomena of electricity; but the bringing it forward at the proper moment,

when the developments of science are able to furnish the means of certain success, and the devising a plan for carrying it into practical operation, are the grounds of a just claim to scientific reputation as well as to public patronage.

About the same time with yourself, Professor Wheatstone, of London, and Dr. Steinheil, of Germany, proposed plans of the electro-magnetic telegraph, but these differ as much from yours as the nature of the common principle would well permit; and unless some essential improvements have lately been made in these European plans, I should prefer the one invented by yourself.

With my best wishes for your success, I remain, with much esteem, yours, truly, JOSEPH HENRY.

Professor MORSE.

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B.

ELECTRO-MAGNETIC TELEGRAPH.

NEW YORK, September 12, 1842.

The undersigned, the committee of arts and sciences of the American Institute, respectfully report:

That, by virtue of the power of adding to their numbers, they called to their aid the gentlemen whose names are hereunto annexed, with those of the original members of the committee, and proceeded to examine Professor Morse's electro-magnetic telegraph.

Having investigated the scientific principles on which it is founded, inspected the mechanism by which these principles are brought into practical operation, and seen the instruments in use in the transmission and return of various messages, they have come to the conclusion that it is admirably adapted to the purposes for which it is intended, being capable of forming words, numbers, and sentences, nearly as fast as they can be written in ordinary characters, and of transmitting them to great distances with a velocity equal to that of light. They therefore beg leave to recommend the telegraph of Professor Morse for such testimonials of the approbation of the American Institute as may in its judgment be due to a most important practical application of high science, brought into successful operation by the exercise of much mechanical skill and ingenuity.

All which is respectfully submitted.

JAMES RENWICK, L. L. D.,
*Prof. Chem, and Nat. Phil., Columbia Coll. N. Y.*
JOHN W. DRAPER, M. D.,
*Prof. Chem. and Min., University, city of New York,*
WILLIAM H. ELLET, M. D.,
*Prof. Chem. etc., Coll. of Columbia, S. C.,*
JAMES R. CHILTON, M. D.,
G. C. SCHAEFFER,
EDWARD CLARK,
CHARLES A. LEE, M. D.

Extract from the minutes of the Institute:

*Resolved.* That the report be accepted, adopted, and referred to the premium committee, and that the recording secretary be directed to publish the same, at the expense of the Institute.

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## C.

New York, December 6, 1842.

Dear Sir:—In compliance with your request, I give you a slight history of my electro-magnetic telegraph, since it was presented for the consideration of Congress, in the year 1838.

During the session of the 25th Congress, a report was made by the Committee on Commerce of the House, which concluded by unanimously submitting a bill appropriating $30,000 for the purpose of testing my system of electro-magnetic telegraphs. The pressure of business at the close of that session prevented any action being taken upon it.

Before the session closed, I visited England and France, for the double purpose of submitting my invention to the test of European criticism, and to secure to myself some remuneration for my large expenditures of time and money in elaborating my invention. In France, after a patent had been secured in that country, my telegraph first attracted the attention of the Academy of Sciences, and its operation was shown, and its principles were explained, by the celebrated philosopher, Arago, in the session of that distinguished body of learned men on September 10, 1838. Its reception was of the most enthusiastic character. Several other Societies, among which were the Academy of Industry and the Philotechnic Society, appointed committees to examine and report upon the invention, from all which I received votes of thanks, and from the former the large medal of honor. The French Government at this time had its attention drawn to the subject of electric telegraphs, several systems having been presented for its consideration, from England, Germany, and France. Through the kind officers of our minister at the French Court, General Cass, my telegraph was also submitted; and the Minister of the Interior (M. Montalivet) appointed a commission, at the head of which was placed M. Alphonse Foy, the administrator-in-chief of the telegraphs of France, with directions to examine and report upon all the various systems which had been presented. The result of this examination (in which the ingenious systems of Professor Wheatstone, of London, of Professor Steinheil, of Munich, and Professor Masson, of Caen, passed in review) was a report to the Minister in favor of mine. In a note addressed to me by M. Foy, who had expressed his warmest admiration of my telegraph in my presence, he thus writes:

"I take a true pleasure in confirming to you in writing that which I have already had the honor to say to you viva voce, that I have prominently presented (signale) to Monsieur the Minister of the Interior your electro-magnetic telegraph, as being the system which presents the best chance of a practical application; and I have

stated to him that if some trials are to be made with electric telegraphs, I hesitate not to recommend that they should be made with your apparatus."

In England, my application for a patent for my invention was opposed before the Attorney General, by Professor Wheatstone and Mr. Davy, each of whom had systems already patented, essentially like each other, but very different from mine. A patent was denied me by the Attorney General, Sir John Campbell, on a plea which I am confident will not bear a legal examination. But there being no appeal from the Attorney General's decision, nor remedy, except at enormous expense, I am deprived of all benefit from my invention in England. Other causes than impartial justice evidently operated against me. An interest for my invention, however, sprung up voluntarily, and quite unexpectedly, among the English nobility and gentry in Paris, and, had I possessed the requisite funds to prosecute my rights before the British Parliament, I could scarcely have failed to secure them, so powerfully was I supported by this interest in my favor; and I should be ungrateful did I not take every opportunity to acknowledge the kindness of the several noblemen and gentlemen who volunteered to aid me in obtaining my rights in England, among the foremost of whom were the Earl of Lincoln, the late celebrated Earl of Elgin, and the Hon. Henry Drummond.

I returned to the United States in the spring of 1839, under an engagement entered into in Paris with the Russian Counsellor of State, the Baron Alexandre de Meyendorff, to visit St. Petersburg with a distinguished French savan, M. Amyot, for the purpose of establishing my telegraphic system in that country. The contract formally entered into, was transmitted to St. Petersburg, for the signature of the Emperor, which I was led to believe would be given without a doubt; and, that no time should be lost in my preparations, the contract, duly signed, was to be transmitted to me in New York, through the Russian ambassador in the United States, in four or five weeks, at farthest, after my arrival home.

After waiting, in anxious suspense, for as many months, without any intelligence, I learned *indirectly* that the Emperor, from causes not satisfactorily explained, refused to sign the contract.

These disappointments, (not at all affecting the scientific or practical character of my invention,) combined with the financial depression of the country, compelled me to rest a while from further prosecuting my enterprise. For the last two years, however, under many discouraging circumstances, from want of the requisite funds for more thoroughly investigating some of the principles involved in the invention, I have, nevertheless, been able to resolve all the doubts that lingered in my own mind, in regard to the perfect practicability of establishing my telegraphic system to any extent on the globe. I say, "doubts that lingered in my own mind;" the principal, and, indeed, only one of a scientific character, which at all troubled me, I will state, and the manner in which it has been resolved:

At an early stage of my experiments, I found that the magnetic power produced in an electro-magnet, by a single galvanic pair, diminished rapidly as the length of the conductors increased. Ordinary reasoning on this fact would lead to a conclusion fatal to the whole invention, since at a great distance I could not operate at all, or, in order to operate, I should be compelled to make use of a battery of such a size as would render the whole plan in effect impracticable. I was, indeed, aware that by multiplying the pairs in the battery—that is, increasing the intensity or its propulsive power—certain effects could be produced at great distances, such as the decomposition of water, a visible spark, and the deflection of the magnetic needle. But as magnetic effects, except in the latter case, had not to my knowledge been made the subject of careful experiment, and as these various effects of electrical action seemed in some respects, to be obedient to different laws, I did not feel entirely assured that magnetism could be produced by a multiplication of pairs sufficiently powerful at a great distance to effect my purpose. From a series of experiments which I made, in conjunction with Professor Fisher, during the last summer, upon 33 miles of wire, the interesting fact, so favorable to my telegraphic system, was fully verified, that *while the distance increased in an arithmetical ratio, an addition to the series of galvanic pairs of plates increased the magnetic power in a geometric ratio.* Fifty pairs of plates were used as a constant power. Two miles of conductors at a time, from two to thirty-three, were successively added to the distance. The weight upheld by the magnet from the magnetism produced by 50 pairs gradually diminished up to the distance of 10 miles; after which, *the addition of miles of wire up to* 33 *miles* (the extent to which we were able to try it) *caused no further visible diminution of power.* The weight then sustained was a constant quantity. The practical deduction from these experiments is the fact that with a very small battery all the effects I desire, and at any distance, can be produced. In the experiments alluded to, the fifty pairs did not occupy a space of more than 8 cubic inches, and they comprised but 50 square inches of active surface.

The practicability of establishing my telegraphic system is thus relieved from all scientific objections.

Let me now turn your attention, sir, one moment to a consideration of the telegraph as a source of revenue. The imperfections of the common systems, particularly their uselessness, on account of the weather, three-quarters of the time, have concealed from view so natural a fruit of a perfected telegraphic system. So uncertain are the common telegraphs as to time, and so meager in the quantity of intelligence they can transmit under the most favorable circumstances, that the idea of making them a source of revenue would not be likely to occur. So far, indeed, from being a source of revenue, the systems in common use in Europe are sustained at great expense; an expense which, imperfect as they are, is justified in the view of the Government, by the great political advantages which they produce. Telegraphs with them are a Government

monopoly, and used only for Government purposes. They are in harmoney with the genius of those Governments. The people have no advantage from them, except indirectly as the Government is benefited. Were our mails used solely for the purposes of the Government, and private individuals forbidden to correspond by them, they would furnish a good illustration of the operation of the common European telegraphic system.

The electro-magnetic telegraph, I would fain think, is more in consonance with the political institutions under wich we live, and is fitted, like the mail system, to diffuse its benefits alike to the Government and to the people at large.

As a source of *revenue*, then, to the Government, few, I believe, have seriously computed the great profits to be derived from such a system of telegraphs as I propose; and yet there are sure data already obtained by which they can be demonstrated.

The first fact is, that every minute of the 24 hours is available to send intelligence.

The second fact is, that 12 signs, at least, can be sent in a minute, instantaneously, as any one may have proof by actual demonstration of the fact on the instrument now operating in the Capitol.

There can be no doubt that the cases, were such speedy transmission of intelligence from one distant city to another is desirable are so numerous, that, when once the line is made for such transmission, it will be in constant use, and a demand made for a greater number of lines.

The paramount convenience, to commercial agents and others, of thus corresponding at a distance, will authorize *a rate of postage proportionate to the distance*, on the principle of rating postage by the mails.

To illustrate the operation of the telegraph in increasing the revenue, let us suppose that but 18 hours of the 24 are efficiently used for the actual purposes of revenue; that 6 hours are allowed for repetitions and other purposes, which is a large allowance. This would give, upon a single circuit, 12,960 signs per day, upon which a rate of postage is to be charged. Intelligence of great extent may be comprised in a few signs. Suppose the following commercial cummunication is to be transmitted from New York to New Orleans.

Yrs., Dec, 21, rec. Buy 25 bales c., at 9, and 300 pork, at 8.

Here are 36 signs, which take three minutes in the transmission from New York to New Orleans, and which informs the New York merchant's correspondent at New Orleans of the receipt of a certain document, and gives him orders to purchase 25 bales of cotton at 9 cents per pound, and 300 barrels of pork as 8 cents per pound. Thus may be completed, in three minutes, a transaction in business which now would take at least four or five weeks to accomplish.

Suppose that one cent per sign be charged for the first 100 miles, increasing the charge at the rate of half a cent each additional 100 miles, the postage of the above communication would be $2,88 for a distance of 1,500 miles. It would be sent 100 miles for 36 cents. Would any merchant grudge so small a sum for sending such an

amount of information in so short a time to such a distance? If time is money, and to save time is to save money, surely such an immense saving of time is the saving of an immense sum of money. A telegraphic line of a single circuit only, from New York to New Orleans, would realize, then, to the Government, *daily*, in the correspondence between those two cities alone, over *one thousand dollars* gross receipts, or over $300,000 per annum.

But it is a well-established fact, that, as facilities of intercourse increase between different parts of the country, the greater is that intercourse. Thousands travel, in this day of railroads, and steamboats, who never thought of leaving their homes before. Estabilsh, then, the means of instantaneous communication between the most distant places, and the telegraphic line of a single circuit will very soon be insufficient to supply the demands of the public—they will require more.

Two circuits will of course *double the facilities, and double the revenue;* but it is an important fact, that the expense of afterwards establishing a second, or any number of circuits, does not proceed on the *doubling* principle. If a channel for conveying a single circuite be made in the first instance of sufficient capacity to contain many more circuits, which can easily be done, additional circuits can be laid as fast as they are called for, at but little more than the cost of the prepared wire. The recent discovery of Professor Fisher and myself shows that a single wire may be made the common conductor for at least six circuits. How many more we have not yet ascertained. So that, to add another circuit is but to add another wire. Fifty dollars per mile, under these circumstances, would therefore add the means of doubling the facilities and the revenue.

Between New York and Philadelphia, for example, the whole cost of laying such an additional circuit would be but $5,000, which would be more than defrayed by *two months'* receipts only from the telegraphs between those two cities.

There are two modes of establishing the line of conductors.

The first and cheapest is doubless that of erecting spars about 30 feet in height and 350 feet apart, extending the conductors along the tops of the spars. This method has some obvious disadvantages. The expense would be from $350 to $400 per mile.

The second method is that of enclosing the conductors in leaden tubes, and laying them in the earth. I have made the following estimate of the cost of this method:

| | |
|---|---|
| Wire, prepared, per mile | $150 00 |
| Lead pipe, with soldesings | 250 00 |
| Delivery of the pipe and wire | 25 00 |
| Passing wire into the pipes | 5 00 |
| Excavations and filling in about 1,000 yards per mile, or 3 feet deep, at 15 cents per square yard | 150 00 |
| Laying down the pipe | 3 00 |
| | 583 00 |

| | |
|---|---|
| One register, with its machinery, comprising a galvanic battery of four pairs of my double-cup battery | $100 00 |
| One battery of 200 pairs | 100 00 |
| Expense for thirty-nine miles | $22,737 00 |
| Two registers | 200 00 |
| Two batteries | 200 00 |
| Services of chief superintendent of construction per annum | 2,000 00 |
| Services of three assistants, at $1,500 each per annum | 4,500 00 |
| | 29,637 00 |

As experience alone can determine the best mode of securing the conductors, I should wish the means and opportunity of trying various modes, to such an extent as will demonstrate the best.

Before closing my letter, sir, I ought to give you the proofs I possess that the American telegraph has the *priority in the time of its invention.*

The two European telegraphs in practical operation are Professor Steinheil's, of Munich, and Professor Wheatstone's, of London. The former is adopted by the Bavarian Government; the latter is established about 200 miles in England, under the direction of a company in London. In a highly interesting paper on the subject of telegraphs, translated and inserted in the London Annals of Electricity, March and April, 1839, Professor Steinheil gives a brief sketch of all the various projects of electric telegraphs, from the time of Franklin's electrical experiments to the present day. Until the birth of the science of electro-magnetism, generated by the important discovery of Oersted, in 1820, of the action of electric currents upon the magnetic needle the electric telegraph was but a philosophic toy, complicated and practically useless. Let it be here noticed, that, after this discovery of Oersted, the *deflection of the needle* became the principle upon which the savans of Europe based all their attempts to construct an electric telegraph. The celebrated Ampere, in the same year of Oersted's discovery, suggested a plan of telegraphs, to consist of a magnetic needle, and a circuit for each letter of the alphabet and the numerals—making it necessary to have some 60 or 70 wires between the two termini of the telegraphic line.

This suggestion of Ampere is doubtless the parent of all the attempts in Europe, both abortive and successful, for constructing an electric telegraph.

Under this head may be arranged the Baron Schilling's, at St. Petersburg, consisting of 36 magnetic needles, and upwards of 60 metallic conductors, and invented, it seems, at the same date with my electro-magnetic telegraph, in the autumn of 1832. Under the same head comes that of Professor Gauss and Weber, of Gottingen,

in 1833, who simplified the plan by using but a single needle and a single circuit. Professor Wheatstone's, of London invented in 1837 comes under the same category; he employs five needles and six conductors. Professor Steinheil's, also invented in 1837, employs two needles and two conductors.

But there was another discovery, in the infancy of the science of electro-magnetism, by Ampere and Arago, immediately consequent on that of Oersted, namely: the electro-magnet, which none of the savans of Europe who have planed electric telegraphs ever thought of applying, until within two years past, for the purpose of signals. My telegraph is essentially based on this latter discovery.

Supposing my telegraph to be based on the same principle with the Europeane lectric telegraphs, which it is not, mine, having been invented in 1832, would still have the precedence, by some months at least, of Gauss and Weber's to whom Steinheil gives the credit of being the first to simplify and make practicable the electric telegraph. But when it is considered that all the European telegraphs make use of the deflection of the needle to accomplish their results and that none use *the attractive power of the electro-magnet to write in legible characters,* I think I can claim, without injustice to others, to be the first inventor of the *electro-magnet telegraph.*

In 1839, I visited London, on my return from France, and through the polite solicitations of the Earl of Lincoln, showed and explained its operation at his house, on the 19th of March, 1839, to a large company, which he had expressly invited for the purpose, composed of Lords of the Admiralty, members of the Royal Society, and members of both Houses of Parliament.

Professor Wheatstone has announced that he has recently (in 1840) also invented and patented an *electro-magnetic telegraph*, differing altogether from his invention of 1837, which he calls his *magnetic-needle telegraph.* His is, therefore, the first European electro-magnetic telegraph, and was invented, as is perceived, eight years subsequent to mine, and one year after my telegraph was exhibited in the public manner described at the Earl of Lincoln's residence in London.

I am the more minute in adducing this evidence of priority of invention to you, sir, since I have frequently been charged by Europeans in my own country with merely imitating long-known European inventions. It is therefore due to my own country, as well as to myself, that in this matter the facts should be known.

Professor Steinheil's telegraph is the only European telegraph that professes to *write* the intelligence. He records, however, by the delicate touch of the needle in its deflections, with what practical effect I am unable to say; but I should think that it was too delicate and uncertain, especially as compared with the strong and efficient power which may be produced in any degree by the electro-magnet.

I have devoted many years of my life to this invention, sustained in many disappointments by the belief that it is destined eventually to confer immense benefits upon my country and the world.

I am persuaded that whatever facilitates intercourse between the different portions of the human family will have the effect, under the guidance of sound moral principles, to promote the best interests of man. I ask of Congress the means of demonstrating its efficiency.

I remain, sir, with great respect, your most obedient servant,

SAMUEL F. B. MORSE.

HON. CHARLES G. FERRIS,

*Member of the House of Representatives from the city of New York, and one of the Committee on Commerce, to whom was referred the subject of the expediency of adopting a system of electro-magnetic telegraphs for the United States.*

The following is the alphabet for Morse's electro-magnetic telegraph:

| ALPHABET | | NUMERALS | |
|---|---|---|---|
| A | · — | 1 | · — — · |
| B | — · · | 2 | · · — · · |
| C | · · · | 3 | · · · — · |
| D | — · · | 4 | · · · · — |
| E | · | 5 | — — — |
| F | · — · | 6 | · · · · · · |
| GJ | — — · | 7 | — — · · |
| H | · · · · | 8 | — · · · · |
| IY | · · | 9 | — · · — |
| K | — · — | 0 | ———— |
| L | ———— | | |
| M | — — | | |
| N | — · | | |
| O | · · | | |
| P | · · · · · | | |
| Q | · · — · | | |
| R | · · · | | |
| SZ | · · · | | |
| T | — | | |
| U | · · — | | |
| V | · · · — | | |
| W | · — — | | |
| X | · — · · | | |

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## FOOD OF GARDEN PLANTS.

It is obvious that a cabbage, a pine apple, or a primrose, can no more live without a due supply of food, than a rabbit or a canary bird; but animals must moreover have a peculiar kind of food; the rabbit, greens and oats; and the canary, rape, millet, or other small seeds; while in the case of plants, which are fixed to a spot and cannot travel about to select their food, such differences, when

they do exist, are not often of practical importance, the food of all plants being nearly, for far as it is known, very similar in kind.

The principal difference in most garden plants compared with others is their greater delicacy; and hence, so far as practice is concerned, their food must require if I may use the term, more delicate and refined *cooking*, and management. This will appear as we proceed, in the several branches into which it will he advantageous to divide our subject, beginning with what may be termed Garden Chemistry, meaning thereby a detail of the chemical elements which enter into the food of garden plants.

*Garden Chemistry.*—Passing over, for the present, the food on which young plants are nourished at their first germinating from seed, which is as different, as we shall afterwards see, as the milk diet of our own infancy is from beef and bread,—let us consider the food requisite for plants after they have exhaustsd the milky pulp contained in the seed lobes and seed leaves.

After young animals are weaned, they are nourished upon either vegetable or animal substances, or a mixture of both, together with water for drink, that is, a solvent to dissolve the more solid matters. These have to undergo the process of digestion in the stomach, where the heat is uniformly ninety-eight degrees, and the mixture of the various substances effected by the motion of the stomach, which is similar to that of an earth-worm. On the pulpy mass thus produced in the stomach passing onwards into the chyle-gut, it is mixed with a portion of bile which separates it into two portions, —one useless, that passes off through the bowels, and another useful which is taken up by the mouths of innumerable small tubes that open on the inner surface of the intestines, and after all these small tubes unite into a single large one, they discharge this useful portion into the blood. Such, in brief, are the first processes by which animals are nourished with food.

Plants, on the other hand, having no stomach, like animals, for the digestion of food, and not being capable of travelling from the spot where they are planted, (except very partially by extending their roots,) must depend altogether on what they can meet with there.

We find, accordingly, in the surface earth, or soil where the roots of plants are, that processes are always going on very similar to digestion in the animal stomach; I mean, that portions of animal and vegetable substances in the soil are dissolved (I might in one sense say digested) and mixed with the water and air diffused through the soil.

In this point of view, the whole of the soil where a plant is rooted, may be considered as similar to the mass produced in the animal stomach by the first process of digestion, and consisting of two portions, one useful and the other useless. The soil would thence appear to perform an office, similar to that of the animal stomach, in preparing the food of plants,—the process, independent of other circumstances, going on more slowly from deficiency of heat in the soil, which in this climate at least, is, on an average, far below ninety-eight degrees, which is the heat of the animal stomach.

The only thing in the soil that appears similar to the motions of the bowels of animals, by which the digested food is brought to the mouths of the little tubes, to be forwarded to the blood, is the motion of the water, or moisture in which the useful portion of the vegetable and animal substances are dissolved, a motion quite indispensable, as we shall afterwards see. This water being then diffused through the soil, a portion of it must offer itself to the tips of the root fibres, or rootlets, where are suckers somewhat similar to those on the inner surface of the animal intestines.

It being of the first importance to ascertain of what materials the useful portion of the substances thus dissolved in water consist, many experiments have been made for that purpose: but the great difficulty of the subject has caused much diversity of opinion among those who have engaged in the inquiry. As it would, I think, be unprofitable, if not injurious, to distract the beginner with conflicting views here, which he can examine at leisure in larger works, I shall confine myself to what is least disputed and most generally adopted.

Upon trying, by means of chemical tests, the materials taken up by plants from the soil, they are found to consist of water, with which are mixed carbonic acid gas, and nitrogen or azote, along with a few other principles, usually in small proportions, which it may be well to examine separately.

*Water.*—From experiments made by Van Helmont and Boyle, who reared plants in earth previously dried in an oven, and by Du Hamel and Bonnet, who reared others upon sponges and moss supplied only with water, it was concluded that water alone is the food of plants; though the inference is faclty, in consequence of overlooking what might be contained in the water before it was used, and also what it might afterwards derive from the atmosphere as well as from the earth or the sponge. That water, indeed is not all the food necessary, was proved by the plants so treated not remaining healthy; and it is well known, that though hyacinths and other bulbs will flower in glasses containing nothing but water yet they never in such cases form seed: and if thus kept for a few months, they will infallibly die, as other plants do when placed in calcined or roasted sand, and watered with distilled water. The hyacinths in glasses, moreover, are not found to thrive unless the water is frequently changed, indicating, that it is not the water alone, but something in the water which has become exhausted, or at least deteriorated, by the slimy matter thrown out by the roots.

The materials, which water holds or may hold disolved, are therefore important to be ascertained, and this may be partially known by color, taste, or smell, but more correctly by chemical tests. It is only, however, requisite for gardening purposes to discover the materials which may prove useful or hurtful, and these, for the most part, are but few in number.

Among the substances useful to vegetation dissolved in the water of soils, may be reckoned atmospheric air, carbonic acid gas, hydrogen gas, humic acid, and a small portion of the salts of lime and potass.

Among the things hurtful are most of the acids, the salts of magnesia and iron, metallic substances in general, and stagnant water.

It is also important to bear in mind, that the purest water is not a simple substance, but composed, as discovered by Cavendish, of eight parts oxygen gas, and one part hydrogen gas, or two volumes of hydrogen and one of oxygen, the correctness of which composition is proved by exploding, or burning these proportions of the two gases together, when the result is pure water. Plants seem to have the power of decomposing the water which enters into their system from the earth or the air; that is, of separating it into its component parts, oxygen and hydrogen.

*Atmospheric Air.*—All water openly exposed contains more or less of the air of the atmosphere, which consists of two gases, namely, twenty-one parts, by measure, of oxygen, and seventy-nine parts of nitrogen or azote with, in general, about one thousandth part of carbonic acid gas. It is chiefly owing to the atmospheric air, and a little carbonic acid gas, that common water, though said to be tasteless, is agreeable to drink; for when these are expelled by boiling, it taste vapid and unpleasant.

That the air contained in the water which enters into plants is important to vegetation, appears from water being found beneficial in proportion as it has had opportunities of becoming mixed with air. When meadows accordingly are laid under water artificial in the process of irrigation, it is found rather hurtful than beneficial if the water is not kept in motion, but allowed to stagnate.

It is on this account, that the water of rivers which run a long course, is much better for watering than that of springs or lakes, whose waters contain but a small portion of air, though this does not apply so well to the stagnant water of ponds or ditches whose deficiency as to atmospheric air is compensated by the greater portion of carbonic acid and other substances derived from the decaying animal and vegetable substances usually abundant in such places.

The best water however, with respect to the quantity of atmospheric air, is rain, which falling in small drops, often tossed about by the wind, has an opportunity of collecting a large proportion of air during its descent to the earth; and hence, the smaller the bore of the holes in the rose of a garden watering-pot the better.

As water becomes mixed with air by exposure and agitation, so does the air become mixed with water by its rising in vapor, and the driest air accordingly always contains more or less water in the state of invisible vapor. The quantity of this vapor is in proportion to the temperature; and hence, the warmer the air the greater proportion of vapor it contains. A beautiful provision for affording some little refreshment to plants at the very time they exposed to exhaustion in hot weather, the operation of which we shall afterwards see when we come to consider the use of leaves.

*Carbon and Carbonic Acid Gas.*—Carbon is pure charcoal, which is well known and easily proved to form a large proportion of most vegetable substances,—the oak, for example contains sixty ounces in a cubic foot; consequently the living plant must have the power

of deriving it from carbonic acid gas, for it has been proved by the experiments of Sir H. Davy, that the most finely powdered carbon is not taken up by plants in the solid form. Nothing, indeed is more hurtful to plants than smoke, which is carbon mixed with watery vapor: though soot, which is condensed and collected smoke, is useful when spread upon the soil, so that water may derive from it a portion of its gases.

All animal and vegetable substances in a state of fermentation or putrefaction, give out a considerable portion of carbonic acid gas, and if it is not dissipated by heat, but confined on or beneath the surface of the soil, it will become mixed with the moisture there, and be taken up by the spongelets or the roots of plants. A great quantity of carbonic acid is also produced by the breathing of animals and by burning wood, peat, or coal; and being heavier than the air of the atmosphere, it must all descend, in the first instance, to near the surface of the soil, into which much of it must be carried by rains and dews. When it becomes diffused in the air however, its weight has little influence in causing it to descend.

The carbonic acid gas thus mixed with water, and taken up along with it into the system of plants, is there decomposed, as we shall afterwards see, into its constituent parts of oxygen and carbon, part of the oxygen being given off into the air, and the rest with the carbon remaining in the plant, where it goes to form most of the solid parts as well as the nutrient pulp.

The carbonic acid also exists in soils combined with lime, magnesia, iron, and some other substances in the form of carbonates. which are soluble with great difficulty in very small quantities in water, but readily in humic acid, as we shall immediately see.

*Nitrogen or Azote.*—This gas, as we have already seen, constitutes by much the largest portion of the atmospheric air, and consequently must enter largely into the system of a plant, though it is not found in general to contribute so much to vegetable as it does to animal substances, in all which azote is in considerable proportion.

Azote is found in larger quantity in cabbages, savoys. cauliflower brocoli, sea-kale, turnips, radishes, mustard, and cresses, than in any other garden plants, and it is this which in part produces in these the peculiar acrid taste which most of them possess. It is also a chief ingredient in starch and in the gluten of wheat. It is the nitrogen also, which, escaping from these when boiled, or when in a state of fermentation or decay, is diffused around and produces an odor in general very strong aud disagreeable.

It will follow, that as these plants when healthy, contain much nitrogen it ought in rearing them to be abundantly supplied from its two chief sources—the air and decaying animal substances,—in other words, by free air and animal manure. Though when it is an object, as in the rearing of sea-kale, to render the flavor mild, the supply of nitrogen must for the reason be diminished: